Brüel & Kjær

2307
Level Recorder

Valid from serial no. 1 055 868

037-0107

Service

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Modifications

Due to the constant technical progress the instrument will be modified from time to time in order to provide continously improved performance.

For this reason there may be small differencies between the instrument and the Service Instruction.

However, the local Representative Service is in possession of all information regarding the modifications that have been made.

Spare Parts

Please state type and serial number of the instrument when ordering spare parts.

Trouble Shooting

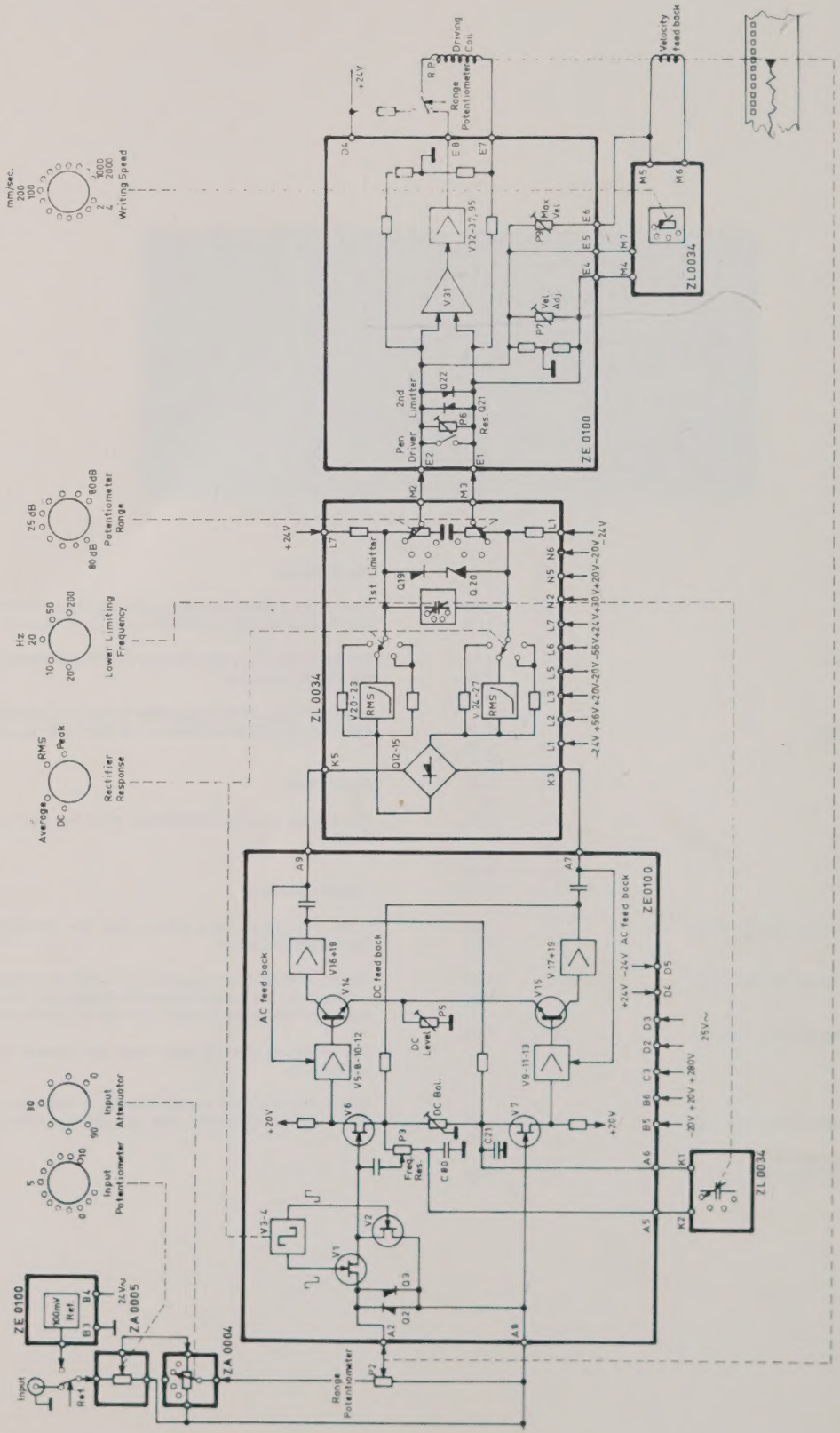
If any fault should occur please check the instrument according to the Adjustment Procedure.

When a fault has been traced and corrected, the voltages and adjustments influenced by the correction must be rechecked. The complete instrument should then be tested to make sure that all basic functions are operative.

The tolerances given in these notes are intended for use as guide for adjustments.

Before correcting any apparent deviation make sure that the measuring instrument has tolerances small enough not to affect the measurement.

Simplified Diagram of the Recorder Amplifier



The Level Recorder Type 2307 consists mainly of a Recording Amplifier, an Electro-dynamic Writing System, a Paper Drive System and a Power Supply.

RECORDING AMPLIFIER

a. Input Amplifier

The input of the Level Recorder is unsymmetrical. The signal is first fed through the continuously variable INPUT POTENTIOMETER and then to the calibrated INPUT ATTENUATOR. Due to stray capacitance in the INPUT POTENTIOMETER the frequency response at the highest frequencies will be affected if the INPUT POTENTIOMETER is not set at position "10".

The calibrated INPUT ATTENUATOR enables the input signal to be accurately attenuated in six 10 dB steps to within ± 0.2 dB.

From the INPUT ATTENUATOR the signal is fed to the Range Potentiometer. In the Range Potentiometer there are precision resistors connecting the 216 silver lamellae that make contact with the slider which is attached to the pen drive. The Range Potentiometer sets the dynamic range and response of the Level Recorder.

The pick off voltage from the slider is fed to an electronic chopper operating at 1 kHz. The chopper consists of two Field Effect Transistors (FET's) which are switched "on" and "off" 1000 times every second.

They are switched in antiphase and when they are switched "on" one passes the signal to the AC input amplifier and the other shortcircuit the input of the amplifier to ground during the remaining time of the switching cycle. Their chopping function is selected only when the Level Recorder is switched to record DC levels.

In the other three positions of the RECTIFIER RESPONSE selector a fixed –20 V is applied to the base of V 3 via R 36 locking the multivibrator in the state where the signal is allowed to proceed to the AC input amplifier.

The balanced input amplifier is DC coupled and provided with both AC and DC feed-back. The AC gain is approx. 70 dB.

b. Rectifier

The output from the input amplifier is applied to a bridge type full wave rectifier. The RECTIFIER RESPONSE networks are symmetrically disposed with respect to ground which ensures that the resolving power in the pen drive system is maintained for both rising and falling signals.

The specially designed rectifier circuit can be switched to measure either the true RMS, the arithmetic average or half the peak to peak value of the input signal.

RMS detection makes use of the highly accurate principle of a biased diode and transistor which performs to within ± 0.5 dB, in this case up to a crest factor of 10.

Following the rectifier circuit is the LOWER LIMITING FREQUENCY response circuit which has an initial effect on the averaging of the measured signal.

This circuit determines the lowest frequency to which the Level Recorder will respond linearly. It can be set to either "2", "10", "20", "50" or 200 Hz by the selector O 2. LOWER LIMITING FREQUENCY. At each of these roll-off frequencies the response of the Level Recorder drops by 0.3 dB.

c. Output Amplifier

The driving system is protected from being over driven by the first limiter (Q 18, 19 and 20). The threshold of the limiter is designed so that the drive system reaches full driving power when the signal fluctuation reaches its limit.

The output signal from the first limiter (DC) is compared with a built-in balanced DC reference voltage to produce a difference signal which is used to drive the output amplifier via a second limiter.

This difference signal is attenuated in steps by an attenuator marked POTENTIOMETER RANGE. The attenuator setting determines the resolving power of the Recorder which is the ability to faithfully follow detail fluctuations in the signal level.

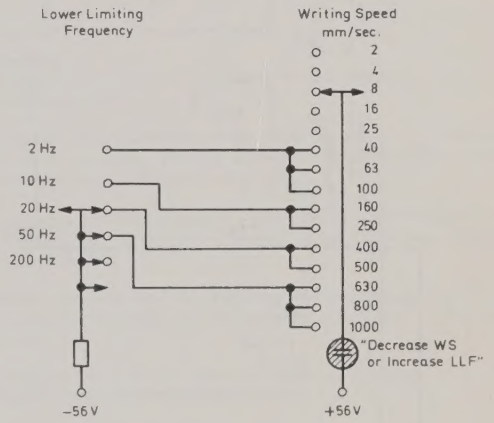
From the POTENTIOMETER RANGE attenuator the signal is fed to the second limiter. The reason for the second limiter is to ensure that the drive signal to the output amplifier section is independent of the magnitude of the servo error signal once it has reached a certain value.

This means that the signal to the output amplifier section will remain equal to, or less than, a fixed value.

The output amplifier consists of an integrated circuit DC amplifier and a push-pull DC power amplifier. This latter stage operates as a type of single ended push-pull amplifier. From a special winding on the moving coil of the electromagnetic drive system a velocity dependent signal is induced.

The signal is introduced as negative feed back to the input of the output amplifier section. The feed back signal will completely control the output signal from this section as long as the signal from the second amplitude limiter has reached its constant value, which is the case when the limiter is in action.

The speed of the writing system, and hence its averaging effect on the recorded levels, can be adjusted according to the figures around the WRITING SPEED control knob.



The stability of the complete system is determined by the combined settings of WRITING SPEED, LOWER LIMITING FREQUENCY and POTENTIOMETER RANGE.

Is the correct setting of POTENTIOMETER RANGE selected for the Range Potentiometer in use, overshoot and instability in the system could be caused by selecting too high a WRITING SPEED in relation to the setting of LOWER LIMITING FREQUENCY.

A lamp marked "Decrease WS or Increase LLF" will light up if the limit for a stable operation is exceeded.

d. Removal of the Range Potentiometer

When the Range Potentiometer is removed great care must be taken not to damage the slider. By having the writing system all the way to the right damaging the slider is minimized.

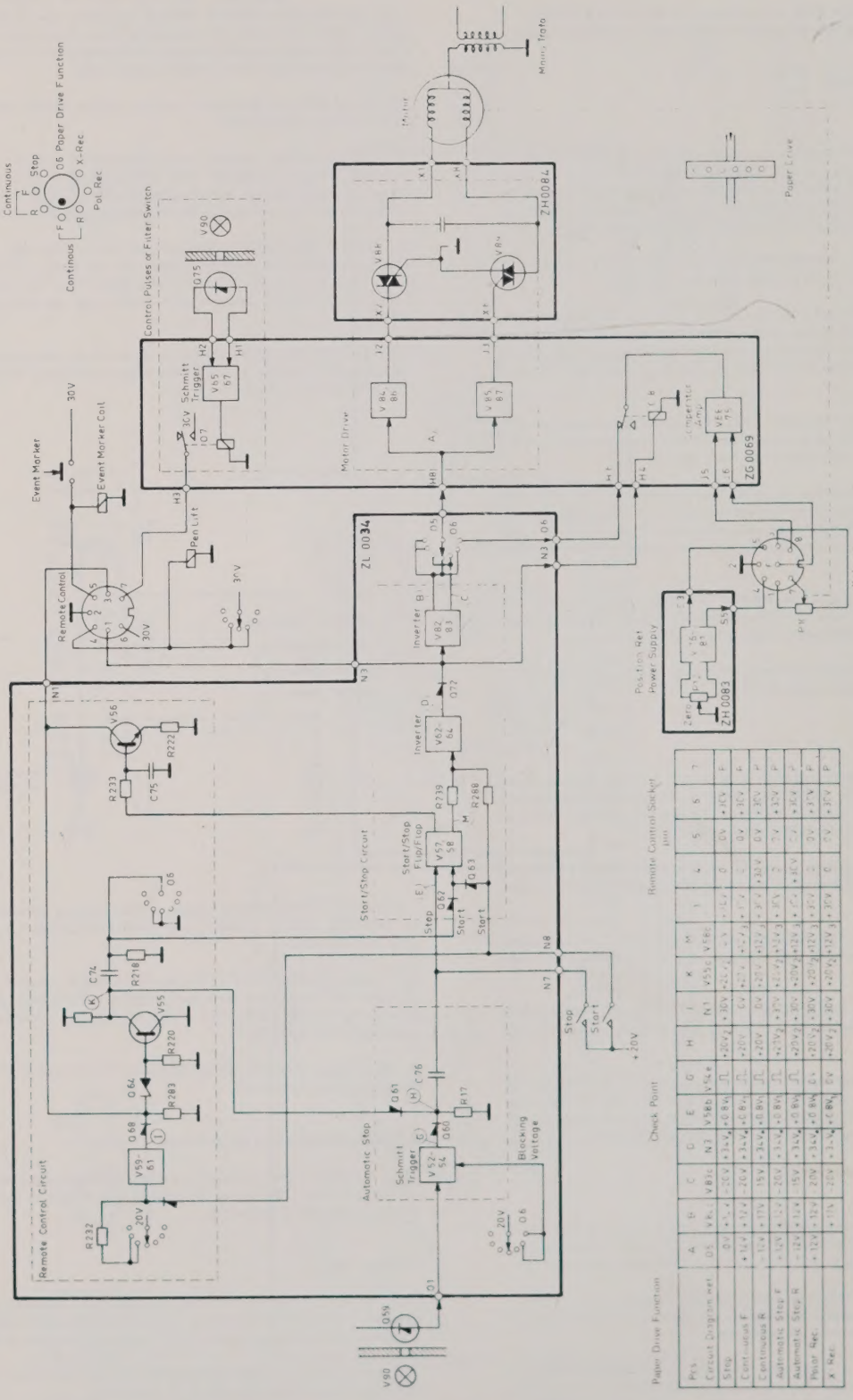
1. Power "ON"

When the screw, by which the Range Potentiometer is mounted in the unit, is loosened a microswitch disconnect the moving coil from the output amplifier and connect the coil to the fixed + 24 V supply via a resistor (R 152).

The writing system will then go to the right and the current is limited to 1/10 of the current normally supplied by the amplifier.

The function is independent of the position of the Standby/Operation selector.

Simplified Diagram of the Control Circuit



Pin / Circuit Diagram ref.	A 05	B Vbk.	C V86c	D N3	E V86b	G V84	H	I N1	K V55c	M V86	1	4	5	6	7
Stop	0V	+34V*	+26V*	+34V*	+0.8V*	⎍	+20V*	+30V*	+20V*	+34V*	0	0V	+4V	0	F
Continuous F	+12V*	+12V*	+20V*	+34V*	+0.8V*	⎍	+20V*	0V	+20V*	+34V*	0	0V	+3V	0	F
Continuous R	-12V*	+11V*	-15V*	-34V*	+0.8V*	⎍	+20V*	0V	+20V*	+34V*	0	0V	+3V	0	F
Automatic Step F	+12V*	+12V*	+20V*	+34V*	+0.8V*	⎍	+20V*	+30V*	+20V*	+34V*	0	0V	+3V	0	F
Automatic Step R	-12V*	+12V*	-15V*	+34V*	+0.8V*	⎍	+20V*	+30V*	+20V*	+34V*	0	0V	+3V	0	F
Paper Rec.	+12V*	+12V*	20V*	+34V*	+0.8V*	0V	+20V*	+30V*	+20V*	+34V*	0	0V	+3V	0	F
X Rec.	+12V*	+11V*	-20V*	+34V*	+0.8V*	0V	+20V*	+30V*	+20V*	+34V*	0	0V	+3V	0	F

* = + 34V when the motor is running and 0V when it is stopped
1 = + 0.8V when the motor is running and 0V when it is stopped
2 = when the start knob is activated
3 = when the motor is running
P = pulses

1.2 Paper Drive System

In the paper drive system the Start, Stop, Forward and Reverse functions of the meter is controlled by electronically switch circuits. The motor is a reversible synchronous motor with very short start and stop times thus avoiding the use of mechanical clutches.

When the Level Recorder is switched to one of the "Cont. Record" or "Automatic Stop" positions and a power failure should occur the paper drive system will automatically get "stop" information when Level Recorder start up again.

Stop
The start/stop flip-flop is locked in the stop position by +20 V supplied via the selector O 6 and resistor R 230. The paper can stepwise be moved forward by pressing START.

Continuous Recording, forward:
The start/stop flip-flop is set by pressing START. This will change the output from the inverter V 62-64 from 0 to + (check point "B") and the motor will start in forward direction.

+20 V applied to the inverter V 59-61 through a section of PAPER DRIVE FUNCTIONS will change the voltage in check point "1" from + to 0. This 0 is inverted in V 55 giving a blocking voltage to the gate for automatic stop.

The paper drive can be stopped by pushing the button STOP.

Continuous Recording, reverse:
As above mentioned except that a section of PAPER DRIVE FUNCTIONS select the – output from the inverter V 82,83 (check point "C") causing the motor to move in the opposite direction. Another section of PAPER DRIVE FUNCTIONS activates the pen lift relay.

Automatic Stop, forward:
The start function operates as for Continuous Recording but the blocking voltage to the gate for automatic stop is removed in this position of PAPER DRIVE FUNCTIONS.

On one side of the paper wheel is a lamp which, through a slot in the wheel, will give light to a photodiode, when the wheel is in the correct stop position. The signal from the photodiode activates a Schmitt-trigger the output of which, via the gate, is applied to the start/stop flip-flop.

Automatic Stop, reverse:
As above except that the – output from the inverter V 82,83 is used to operate the motor.

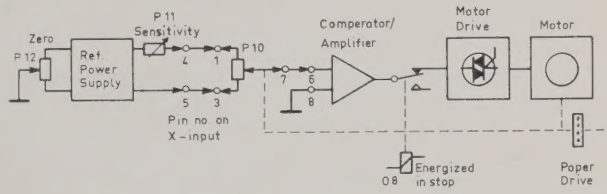
The pen lift relay is also activated.

Polar Recording:
This position is used when the Level Recorder is used with the Turntable Type 3921 or 3922.

The built-in stop function in the Turntable will stop both units when the Turntable has completed one revolution.

Both units can be started from either the Turntable or the Level Recorder.

By pushing STOP on the Level Recorder both units can be stopped. To continue the sweep START on the Level Recorder should be pushed.



X-Recording:
In this position the paper drive system can be controlled by an external applied voltage ramp.

The principle of operation is based on "Error reducing system" whereby the existence of a potential difference across a differential amplifier results in a proportional voltage across a secondary circuit.

The secondary circuit forms a part of the system which is designed to reduce the originally applied potential difference across the differential amplifier thus closing the loop.

A variable floating voltage for use across P 10 is available across pin 4 and 5. The potential difference can be varied by adjusting P 11 X-Recording Sensitivity.

The absolute level of this potential difference compared to ground is adjustable by means of P 12, X-Recording Zero.

The secondary circuit comprises the meter control which via the paper drive rotate the wiper of P 10 in order to produce a sliding voltage pick off at pin 7. This voltage is applied to one input of a differential amplifier where it is compared against the voltage applied to the other input (ground). If there is a potential difference then the amplifier will continue to activate the motor circuit until this difference, within the resolution of the system, is reduced to zero.

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2.1. Voltage

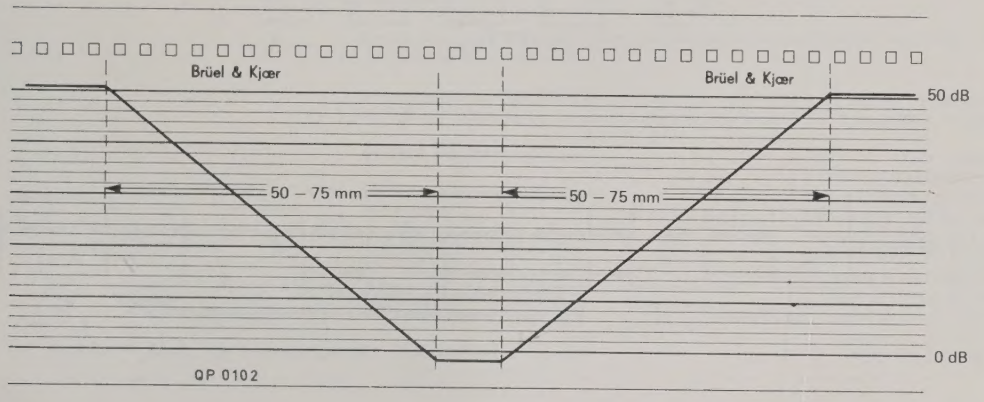
Before any repair or when a fault has been found and corrected the Level Recorder should be tested according to item 3.2 to 3.4 to make sure that the basic function is operative.

DC Voltage

+ 20 V	F 8	ZG 0069
– 20 V	F 9	
+ 24 V	D 4	ZE 0100
– 24 V	D 5	
+ 30 V	O 4	ZL 0034
+ 56 V	G 4	ZG 0069
– 56 V	G 5	
+ 235 V	C on V 30	ZE 0100

AC Voltage

24 V ~ F 1,2	ZG 0069
24 V ~ B 4	ZE 0100
25 V ~ D 2,3	ZE 0100
50 V ~ G 1,2	ZG 0069



2.2. Writing Speed

PEN DRIVE: "On"
INPUT ATTENUATOR: "0"
INPUT POTENTIOMETER: "10"
WRITING SPEED: "8 mm/sec"
LOWER LIM. FREQ.: "200 Hz"
RECTIFIER RESPONSE: "RMS"
POTENTIOMETER RANGE: "50 dB"
WRITING WIDTH: "50 mm"
PAPER DRIVE FUNCTION: "Cont. Forward"
PAPER SPEED: "10 mm/sec"
Paper: QP 0102 (QP 0224)

Input signal. 4 V, 1000 Hz.

Start the paper drive by pressing START and remove the input signal while the paper is running.

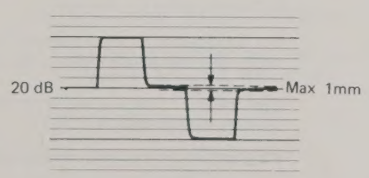
When the sapphire has reached the 0 dB line apply the signal again.

The paper length for a movement of the sapphire from 50 dB to 0 or from 0 to 50 dB should be 62 mm.
Tolerance ± 20%. Measured on the paper 50 – 75 mm.
If necessary adjust P 7. Vel. Adj.

Possible reason for faults: Defective feed-back coil
Unbalanced Input amp. Check 2.6
Unbalanced Output amp. Check 2.5

WRITING SPEED to "1000 mm/sec"
PAPER SPEED to "100 mm/sec"

Check as above.
Tolerance: ± 20%. Measured on the paper 4 – 6 mm.
If necessary adjust P 9. Max. Vel.



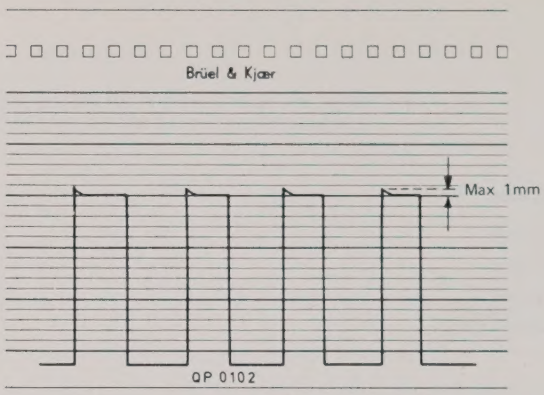
2.3. Resolving Power

PEN DRIVE: "On"
INPUT ATTENUATOR: "10"
INPUT POTENTIOMETER: "10"
WRITING SPEED: "16 mm/sec"
LOWER LIM. FREQ.: "200 Hz"
RECTIFIER RESPONSE: "RMS"
POTENTIOMETER RANGE: "50 dB"
WRITING WIDTH: "50 mm"
PAPER DRIVE FUNCTION: "Cont. Forward"
PAPER SPEED: "1 mm/sec"
Paper: QP 0102 (QP 0224)

Start the paper drive by pressing START and adjust the input voltage (at approx. 1 kHz) for a sapphire deflection to the 20 dB line.

Change INPUT ATTENUATOR to "0 dB" and back again to "10 dB". Thereafter to "20 dB" and back to "10 dB".

Check that the sapphire comes back to the 20 dB line. Tolerance: ± 0.5 mm.
Possible reason for faults: Incorrect setting of P 6. Check 2.4
Too low driving Power. Check 2.8
Unbalanced input Amp. Check 2.6
Unbalanced output Amp. Check 2.5



2.4. Overshoot

PEN DRIVE: "On"
INPUT ATTENUATOR: "0"
INPUT POTENTIOMETER: "10"
WRITING SPEED: "800 mm/s"
LOWER LIM. FREQ.: "200 Hz"
RECTIFIER RESPONSE: "RMS"
POTENTIOMETER RANGE: "50 dB"
WRITING WIDTH: "50 mm"
PAPER DRIVE FUNCTION: "Cont. Forward"
PAPER SPEED: "1 mm/sec"
Paper: QP 0102 (QP 0224)

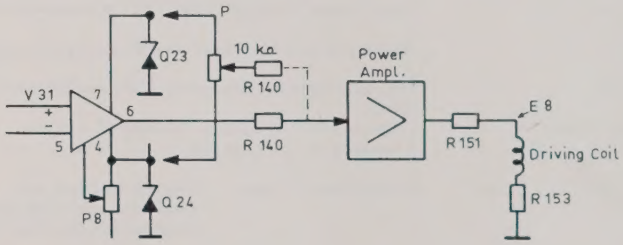
Input signal: 400 mV, 1000 Hz.

Start the paper drive by pressing START.

Disconnect the input signal and check the overshoot when the signal is applied again.

Overshoot: max. 1 mm.
If necessary adjust P 6. Resolution.
Whenever P 6 is adjusted check the resolution power, item 2.3

Possible reason for fault: Writing speed too high. Check item 2.2



2.5. Balance of Output Amplifier

PEN DRIVE: "Off"

Measure the DC voltage across the driving coil (measuring Point E 8): 0 V ± 0.5 V.

If necessary adjust P 8, Balance.

If it is impossible to adjust connecta 10 kΩ potentiometer "P" to the 12 V zener diodes as shown and connect the resistor R 140 to the slider.

Then adjust "P" for 0 V across the driving coil to see if the output stage alone can be balanced (adjustment range approx. ± 18 V).

If 0 V can be obtained now the most possible reason for a fault is V 31.

2.6. Balance of Input Amplifier

PEN DRIVE: "Off"
INPUT ATTENUATOR: "0"
INPUT POTENTIOMETER: "10"

Measure the DC voltage from R 66,68 to R 67,69: 0 V ± 0.5 V.
If necessary adjust P 4, DC balance.

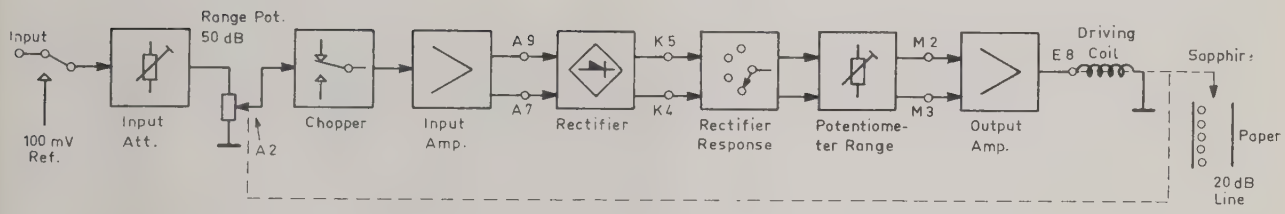
If it is impossible to adjust check the voltages through the stages, where approx. 0 V should be obtainable when measuring from one point in the upper part to the corresponding point in the lower part of the symmetrical input amplifier.

Set the sapphire to the outer right position.
Measure the DC voltage from R 66,68 to ground: approx. 125 V.

In order to overload the amplifier apply a signal 10 V, 1000 Hz to "Input" and note DC voltage variation: max. 2 V.

If necessary adjust P 5, DC level to give the same reading with and without input signal.
P 5 should never be turned to give zero Ω.

If for any reason the FET's V 6 and V 7 has to be replaced turn P 5 to max. resistance before the Level Recorder is switched on to prevent any transistor break-down in the output stage.



2.7. Sensitivity

PEN DRIVE: "On"
INPUT ATTENUATOR: "0"
INPUT POTENTIOMETER: "10"
WRITING SPEED: "100 mm/sec"
LOWER LIM. FREQ.: "20 Hz"
RECTIFIER RESPONSE: "RMS"
POTENTIOMETER RANGE: "50 dB"
WRITING WIDTH: "50 mm"
PAPER DRIVE FUNCTION: "Cont. Forward"
PAPER SPEED: "1 mm/sec"
Paper: QP 0102 (QP 0224)

Input signal. Exactly 100 mV, approx. 1000 Hz.

Start the paper drive by pressing START.

a. Check the regulation range of INPUT POTENTIOMETER.
Deflection for position "0": approx. 15 dB.
Deflection for position "10": approx. 25 dB.

If the sensitivity is too low turn P 6, Resolution to max. resistance and check the signal levels.

Input signal	Measuring point A 2	A 7.9	Cathode Q 12	Anode Q 15	E 8
100 mV	app. 3 mV RMS	10 V RMS	approx. + 9 V	approx. –9 V	0 V
1000 Hz	1000 Hz	1000 Hz	DC	DC	DC

After repair check Resolving Power item 2.3 and Overshoot, item 2.4

b. Adjust INPUT POTENTIOMETER for a deflection to the 20 dB line

Depress "100 mV Ref." and check the deflection. 19.9 – 20.1 dB.
If necessary adjust P 2, 100 mV Ref.

2.8 Max. Driving Power

PEN DRIVE: "On"
INPUT ATTENUATOR: "0"
INPUT POTENTIOMETER: "10"
WRITING SPEED: "2 mm/sec"
LOWER LIM. FREQ.: "200 Hz"
RECTIFIER RESPONSE: "RMS"
POTENTIOMETER RANGE: "50 dB"
WRITING WIDTH: "50 mm"
PAPER DRIVE FUNCTION: "Cont. Forward"
PAPER SPEED: "1 mm/sec"
Paper: QP 0102 (QP 0224)

Input signal. 10 V, 1000 Hz.

Start the paper drive by pressing START.

Connect a DC voltmeter across the driving coil measuring point E 8.

When the input signal is disconnected the voltage should be 1.3 – 2.0 V during the sapphire movement from the 50 dB to 0 dB line. For 100 mm writing width the voltage should not exceed 4 V

As soon as the sapphire stops at the 0 dB line the voltage increase to 18 – 20 V.

If the voltage is higher than 2 V during the movement it indicates that the mechanical friction in the writing system is too high. Check item 3.1

Valid from serial no 377302

2.9. Rectifier Response

PEN DRIVE: "On"
INPUT ATTENUATOR: "0"
INPUT POTENTIOMETER: "10"
WRITING SPEED: "100 mm/sec"
LOWER LIM. FREQ.: "20 Hz"
RECTIFIER RESPONSE: "RMS"
POTENTIOMETER RANGE: "50 dB"
WRITING WIDTH: "50 mm"
PAPER DRIVE FUNCTION: "Cont. Forward"
PAPER SPEED: "1 mm/sec"
Paper: QP 0102 (QP 0244)

Start the paper drive by pressing START.

Adjust the input signal at approx. 1000 Hz until the sapphire is on the 20 dB line

Switch RECTIFIER RESPONSE to "Average"
Sapphire deflection. 10.1 dB

Switch RECTIFIER RESPONSE to "Peak"
Sapphire deflection: 23 dB

Disconnect the AC input signal and connect a DC voltage
The DC voltage will give the same deflection when RECTIFIER RESPONSE is in position DC as an RMS voltage when RECTIFIER RESPONSE is in position RMS

2.10. Frequency Response

PEN DRIVE: "On"
INPUT ATTENUATOR: "0"
INPUT POTENTIOMETER: "10"
WRITING SPEED: "8 mm/sec"
LOWER LIM. FREQ.: "200 Hz"
RECTIFIER RESPONSE: "RMS"
POTENTIOMETER RANGE: "50 dB"
WRITING WIDTH: "50 mm"
PAPER DRIVE FUNCTION: "Cont. Forward"
PAPER SPEED: "1 mm/sec"
Paper: QP 0102 (QP 0224)

Start the paper drive by pressing START.

Adjust the input signal to approx. 1000 Hz until the sapphire is on the 40 dB line

Check the frequency cut off for all positions of LOWER LIM. FREQ. with the signal frequency corresponding to the knob position

Deflection. 40 dB ± 0.3 dB

WRITING SPEED to "500 mm/sec"
LOWER LIM. FREQ. to "200 Hz"

Change the frequency to 200 kHz

Deflection. 40 dB + 0.5 dB, −0.2 dB.
If necessary adjust P 3, Frequency response

Check all positions of INPUT ATTENUATOR.
Attenuator step. 10 dB ± 0.2 dB

2.11. Hum

PEN DRIVE: "On"
INPUT ATTENUATOR: "0"
INPUT POTENTIOMETER: "10"
WRITING SPEED: "100 mm/sec"
LOWER LIM. FREQ.: "10 Hz"
RECTIFIER RESPONSE: "Peak"
POTENTIOMETER RANGE: "8 dB"
WRITING WIDTH: "50 mm"
PAPER DRIVE FUNCTION: "Cont. Forward"
PAPER SPEED: "1 mm/sec"
Paper. QP 0102 (QP 0224)

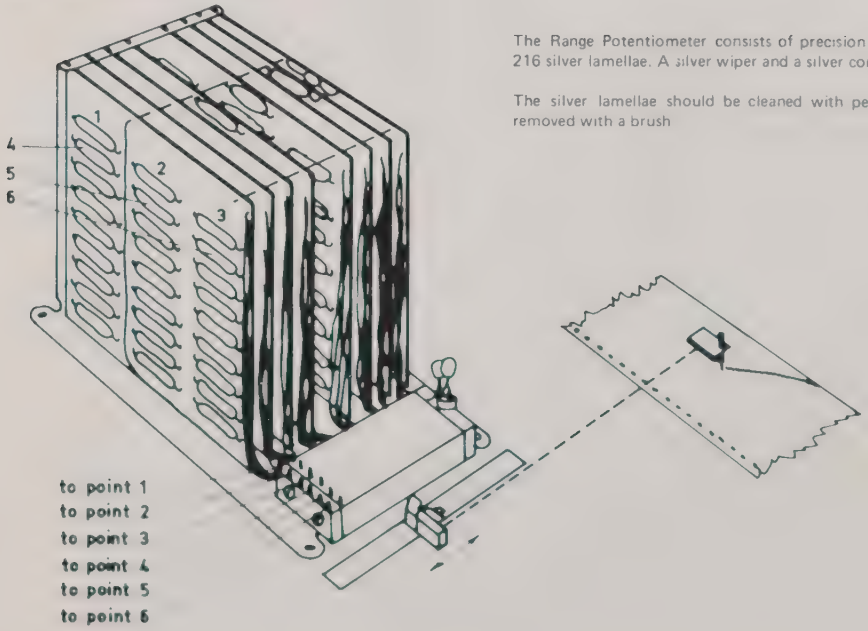
Start the paper by pressing START

Input signal. 15 mV, 1000 Hz

Change the frequency slowly towards the mains frequency and check the sapphire movement

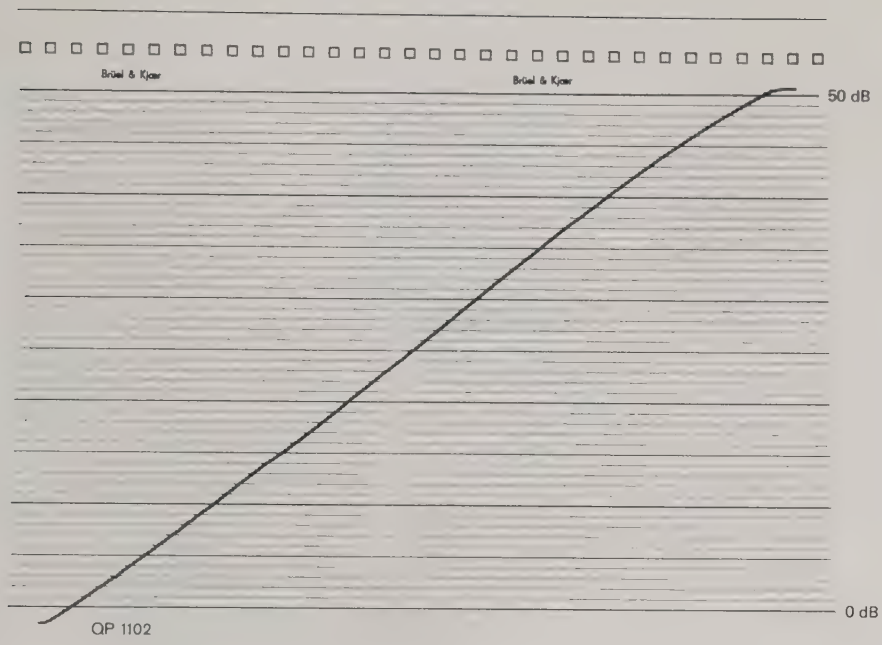
At approx. 2 Hz from the mains frequency a beat may occur, but must not exceed 0.5 mm

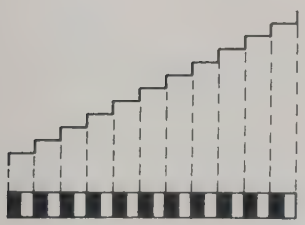
2.12. Check of Range Potentiometer



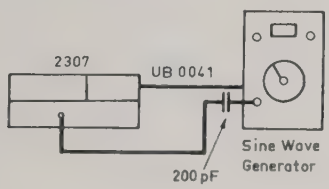
The Range Potentiometer consists of precision resistors connected to a contact strip built up of 216 silver lamellae. A silver wiper and a silver contact strip assure a high signal-to-noise ratio

The silver lamellae should be cleaned with petrol and any metallic dust between the lamellae removed with a brush



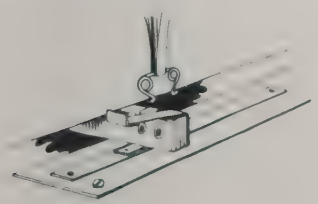


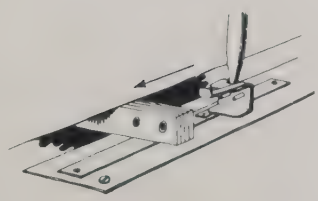
A detailed drawing of the lamellae of the potentiometer and the curve above.
As it can be seen on the drawing, one step on the curve correspond to the slider are moved from one lamellae to another.

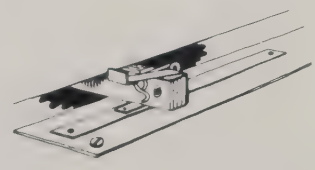


POTENTIOMETER RANGE: "50 dB"
RECTIFIER RESPONSE: "Peak"
LOWER LIM. FREQ.: "2 Hz"
WRITING SPEED: "1000 mm/sec"
PAPER SPEED: "1 mm/sec"
INPUT ATTENUATOR: "0 dB"
Paper: QP 1102
WRITING WIDTH: "100 mm"

Connect 2307 as the drawing shows above.
Adjust the input voltage (at approx. 20 kHz) for a pen deflection to just a little higher than 50 dB line. Turn the generator to approx. 20 Hz and check that the pen deflection is under 0 dB line.
Switch the generator to automatic scanning and start the Level Recorder.
The pen will ladder in steps with 6 dB/oct. as shown in the drawing above.







Replacement of the slider

Remove the Range Potentiometer.
Dismount the locking spring by use of slim pliers.
Dismount the defective slider and mount the new one.
Then the locking spring is put into position behind contact
After replacement regrind the slinder. This is done by placing a piece of the finest glass-paper between the lamellae and the slider and move the pen from side to side.

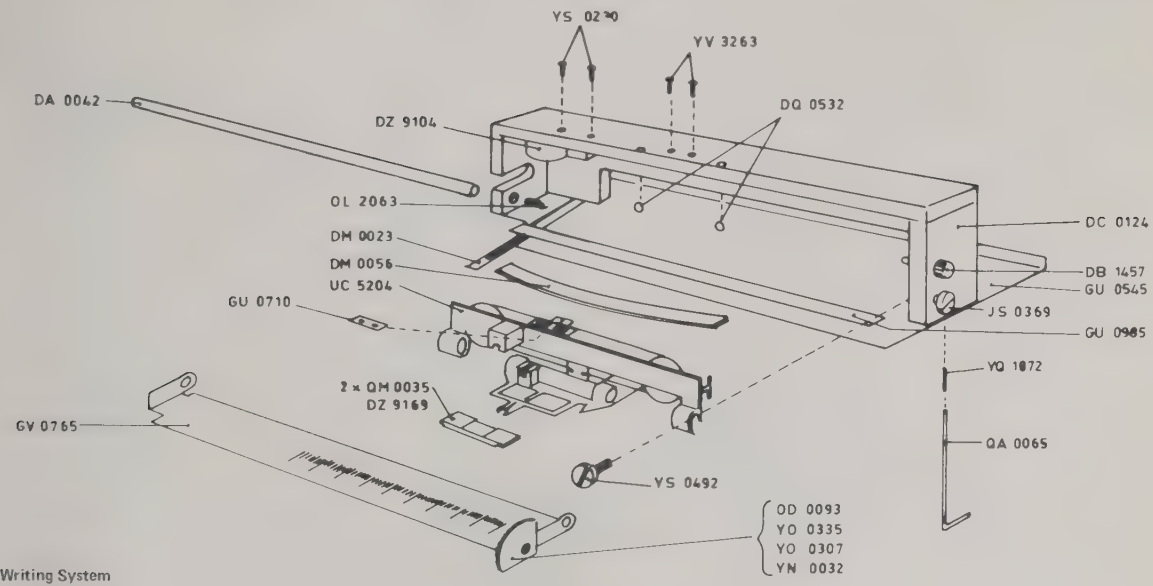
Valid from serial no 377302

2.13. Paper Drive

PAPER DRIVE FUNCTION: "Stop"	Check that the paper move forward only if START is depressed.
PAPER DRIVE FUNCTION to "Cont. Forward"	Start the paper drive in forward direction by pressing START. The paper movement continue until STOP is depressed.
PAPER DRIVE FUNCTION to "Cont. Reverse"	As b but reverse paper movement.
PAPER DRIVE FUNCTION to "Aut. Stop F"	Align the white dot on the AUTOMATIC STOP adjustment wheel with the white dot on the PAPER ADJUSTMENT wheel Insert a recording paper with preprinted frequency lines Set PAPER ADJUSTMENT wheel to a start position of f. inst. 10 Hz Run one chart by pressing START and fine adjust the AUTOMATIC STOP wheel for the exact frequency.
PAPER DRIVE FUNCTION to "Aut. Stop R"	Run one chart and check the stop position. Max. deviation between stop "Forward" and "Reverse": ±1 mm.
PAPER DRIVE FUNCTION to "Polar Recording"	Start the paper drive by START. The paper movement should continue until STOP is pressed.

JP 0802 ext. view

PAPER DRIVE FUNCTION: "X-Rec." PAPER SPEED = Not to exceed 3 mm/sec	An 8-pin DIN plug (B & K Type JP 0802) is wired as shown above and plugged into the "X-Input" socket. Start the paper drive by pressing START and note where the paper stops automatically. Manually move the paper wheel off this position and check that the paper automatically returns to the same position as soon as the paper wheel is released.



3.1. Writing System

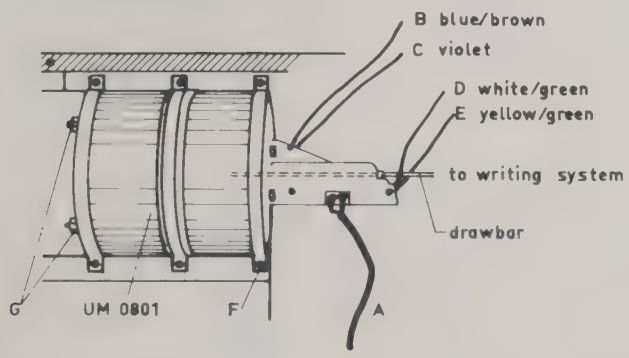
Cleaning

Remove pen and paper.
With a soft cloth and trichlorethylene remove any wax or waster matter from writing plate and bottom plate GU 0545
Also clean the guide bar DA 0042

Adjustment of dB scale:

Set stylus to the position 0 dB an the paper and adjust the screw JS 0369 for a correspond·ing reading on the metallic scale

Note: Under no circumstances should oil be applied to the writing system.



3.2. Magnet System

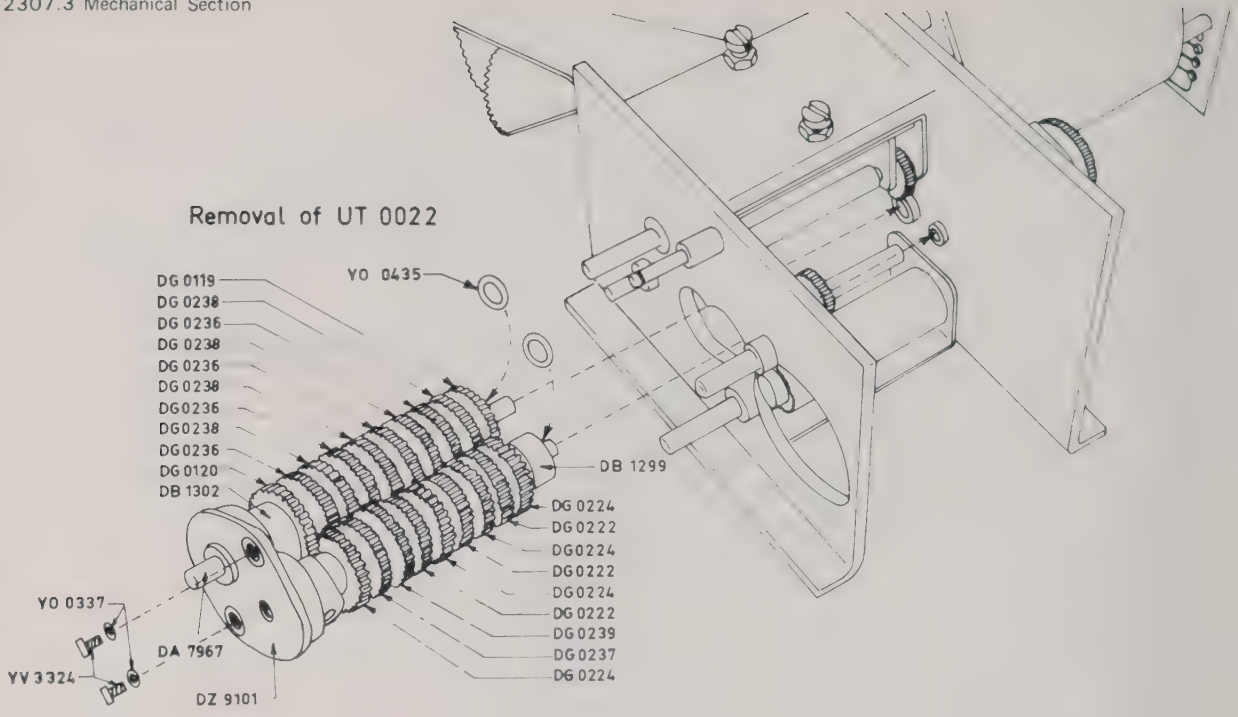
Removal of the Magnet system

Remove the writing Potentiometer.
Disconnect the mechanical connection between the magnet system and the writing system.
Move the drawbar so far to the left side as possible.
Place the instrument with the bottom upward.
Remove the bottom plate and the back plate.
Unsolder the five wires A – B – C – D – E.
Unscrew the six 5 mm screws F
Loosen the four 6 mm nuts G
The magnet system can now be removed
The assembling should take place in the reverse order.

Coil Resistance

Resistance in the coil: Driver coil. approx. 27 Ω
Feedback coil: approx. 1 kΩ

Note: Under no circumstances should oil be applied to the magnet system

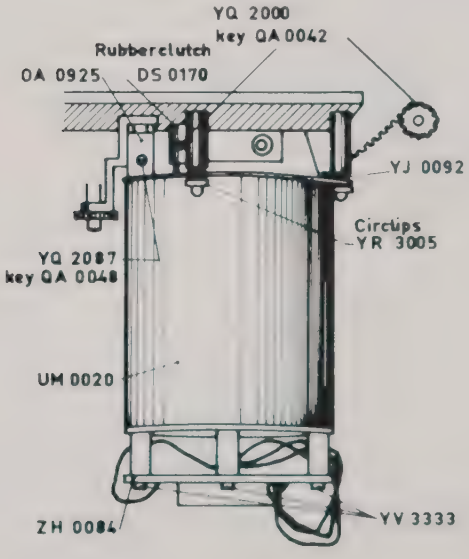


3.3. Gear Box

Removal of the Gear Wheels

Place the instrument with the left side downward
Remove the bottom plate.
Remove the cover on the right side of the instrument.
Dismount the chain wheel on drive shaft I and II (Allen key 1.5 mm)
Dismount the nylon gear wheels for adjustment to mains frequency
Remove the two screws YO 0337.
The gear wheels can now be removed.

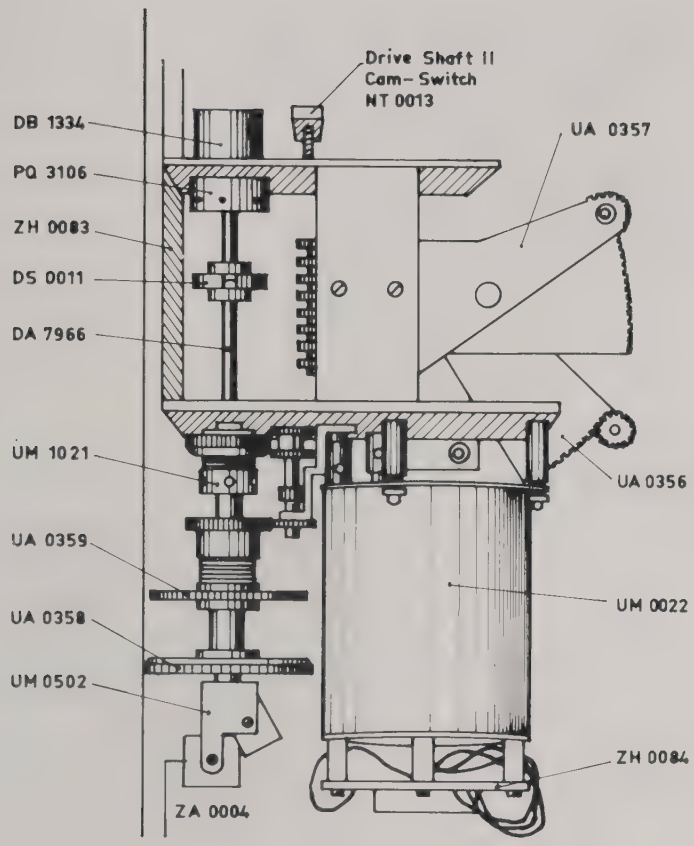
When assembling check that the face for the gear wheels don't touch each other
The distance between the gear wheels can be adjusted by place or replace the space washer YO 0435.



3.4. Motor

Removal of the motor

Unsolder the four wires (white/blue – white/red – yellow – yellow) on ZH 0084
Remove the circuit board ZH 0084 by unscrewing the three screws YV 3333
Unscrew the allen screw YQ 2087 (Allen key 2 mm)
Remove the two circlips YR 3005
The motor can now be removed by pulling it downwards
When assembling remember the rubber clutch between the motor and the gear box



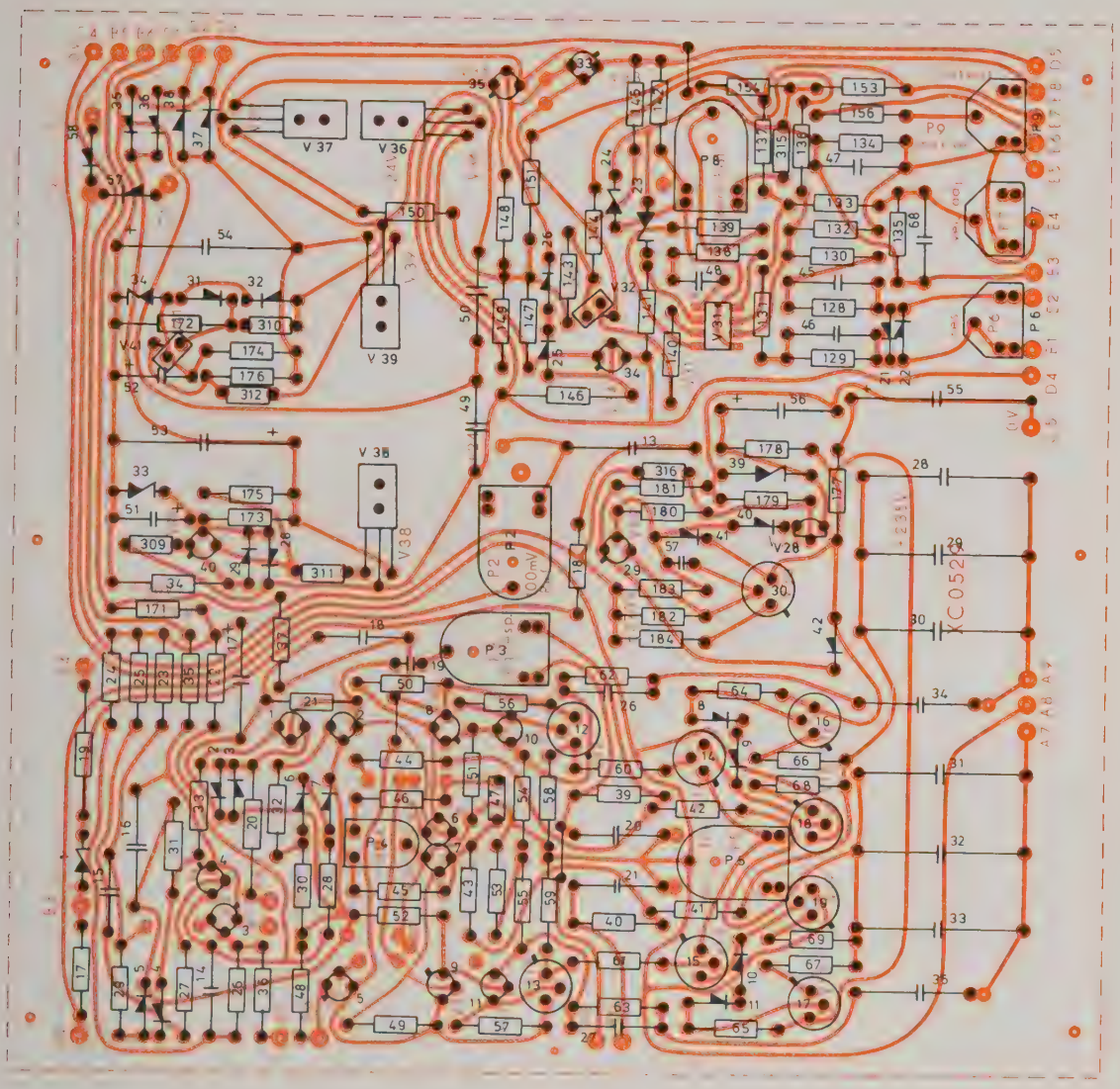
3.5. Friction Clutch

POWER: "On"
PAPER SPEED: "100 mm"

Place a pin tuck in an angle of 90 degrees in Drive Shaft II on the right side of the instrument.
Start the motor by pressing "Start".
Check that the clutch slips at a pressure of 200 g measured on the pin 10 cm from the center.

If necessary adjust UM 1021.

Layout Diagram with Parts List



R C Q V

Viewed from the printed circuit side

C 13	Electrolytic, Bipolar			10 µF/ 63 V	CE 0536
C 14,15	Polyester			12 nF/250 V	CS 0002
C 16,17	Electrolytic			25 µF/ 25 V	CE 2002
C 18	Polyester			0,1 µF/250 V	CS 0013
C 19	Ceramic			1 pF/400 V	CK 0100
C 20,21	Polycarbonate			0,47 µF/100 V	CS 0335
C 26,27	Ceramic			1 pF/400 V	CK 0100
C 28-33	Polyester			2 µF/250 V	CS 0028
C 34,35	-			0,68 µF/250 V	CS 0023
C 45,46	Polystyrene	1%		6,2 nF/ 63 V	CT 1510
C 47	Polyester			68 nF/250 V	CS 0011
C 48	Polystyrene	1%		1 nF/ 63 V	CT 1132
C 49,50	Polycarbonate			0,22 µF/100 V	CS 0339
C 51,52	Electrolytic			5 µF/ 70 V	CE 0200
C 53,54	-			400 µF/ 40 V	CE 0417
C 55	-			8 µF/350 V	CE 0802
C 56	-			4 µF/250 V	CE 2034
C 57	Ceramic			27 pF/400 V	CK 1270
C 68	Polyester			68 nF/250 V	CS 0011

P 2	Trimmer		lin.	10 kΩ	PG 3108
P 3	-		-	50 kΩ	PG 3509
P 4	-		-	470 Ω	PG 1504
P 5	-		-	5 kΩ	PG 2507
P 6	-		-	250 kΩ	PG 4253
P 7	-		-	50 kΩ	PG 3511
P 8	-		-	10 kΩ	PG 3108
P 9	-		-	500 kΩ	PG 4510

Q 1	Zener	ZG5,6		5,0-6,2 V/0,25 W	QV 1105
Q 2,3	Silicon	13P2		200 V/40 mA	QV 0022
Q 4-7	-	1N4148		75 V/75 mA	QV 0216
Q 8-11	-	1N4004		400 V/1 A	QV 0237
Q 21,22	-	1N4004		400 V/1 A	QV 0237
Q 23,24	Zener	MZ716A		11-13 V/0,25 W	QV 1117
Q 25,26	Silicon	1N4004		400 V/1 A	QV 0237
Q 28,29	-	1N4004		400 V/1 A	QV 0237
Q 31,32	-	1N4004		400 V/1 A	QV 0237
Q 33,34	Zener	1N723		21,6-26,4 V/0,25 W	QV 1005
Q 35-38	Silicon	1N4004		400 V/1 A	QV 0237
Q 39	Zener	1N3048B		143-158 V/1 W	QV 1317
Q 40-42	Silicon	1N4004		400 V/1 A	QV 0237
Q 57,58	-	BYX10		1200 V/50 mA	QV 0025

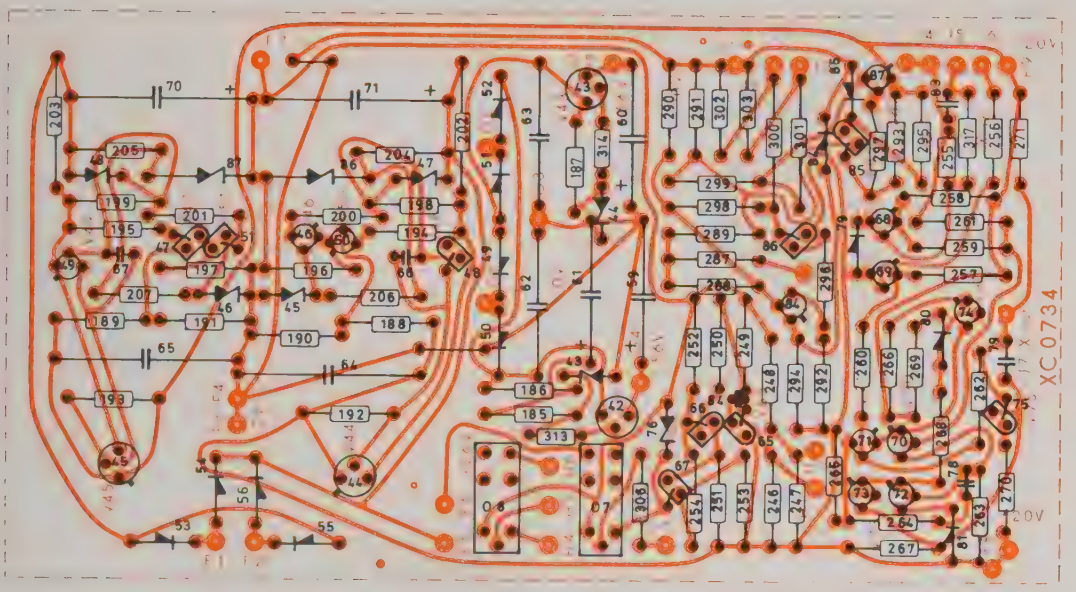
R 17	Metal	1/4 W	1%	499 Ω	RF 2499
R 18	-	-	-	12,1 kΩ	RF 4121
R 19	-	-	-	2,00 kΩ	RF 3200
R 20	-	1/2 W	2%	10,0 kΩ	RF 0105
R 21	-	1/3 W	1%	4,02 MΩ	RH 6402
R 22,23	-	1/4 W	-	3,92 kΩ	RF 3392
R 24	-	-	-	63,4 kΩ	RF 4634
R 25	-	-	-	82,5 kΩ	RF 4825
R 26-29	-	-	-	10,0 kΩ	RF 4100
R 30,31	-	-	-	3,32 kΩ	RF 3332
R 32,33	-	-	-	1,00 MΩ	RF 6100
R 34	-	-	-	549 Ω	RF 2549
R 35	-	-	-	1,50 kΩ	RF 3150
R 36	-	-	-	18,2 kΩ	RF 4182
R 37	-	-	-	95,3 Ω	RF 1953
R 39,40	-	-	-	4,75 kΩ	RF 3475
R 41-44	-	1/2 W	-	330 kΩ	RF 0307
R 45,46	-	1/4 W	-	2,21 kΩ	RF 3221
R 47	NTC	0,4 W		150 Ω	RN 0005
R 48	Metal	1/4 W	1%	4,99 kΩ	RF 3499
R 49,50	-	-	-	33,2 kΩ	RF 4332
R 51,52	-	-	-	4,75 kΩ	RF 3475
R 53	Metal	1/4 W	1%	33,2 kΩ	RF 4332
R 54,55	-	-	-	178 Ω	RF 2178
R 56-59	-	-	-	4,75 kΩ	RF 3475
R 60,61	-	-	-	1,21 kΩ	RF 3121
R 62,63	-	1/2 W	-	270 kΩ	RF 0306
R 64,65	-	1/4 W	-	49,9 kΩ	RF 4499
R 66-69	-	-	-	95,3 Ω	RF 1953
R 128,129	-	-	-	402 kΩ	RF 5402
R 130,131	-	-	-	49,9 kΩ	RF 4499
R 132,133	-	-	-	100 kΩ	RF 5100
R 134,135	-	-	-	1,10 kΩ	RF 3110
R 136,137	-	1/3 W	-	4,02 MΩ	RH 6402
R 138	-	1/4 W	-	301 Ω	RF 2301
R 139	-	-	-	511 kΩ	RF 5511
R 140	-	-	-	95,3 Ω	RF 1953
R 141,142	-	-	-	1,00 kΩ	RF 3100
R 143	-	-	-	10,0 kΩ	RF 4100
R 144	-	-	-	3,01 kΩ	RF 3301
R 145	-	-	-	4,75 kΩ	RF 3475
R 146	Wire	4,2 W	5%	4,70 kΩ	RX 0315
R 147,148	Metal	1/4 W	1%	95,3 Ω	RF 1953
R 149,150	Wire	1 W	2%	2,0 Ω	RO 1106
R 151	-	-	5%	3,0 Ω	RR 0003
R 153,154	-	-	-	1,0 Ω	RR 0001
R 156	Metal	1/4 W	1%	1,00 MΩ	RF 6100
R 171,172	Wire	4,2 W	5%	680 Ω	RX 0317
R 173,174	Metal	1/4 W	1%	2,67 kΩ	RF 3267
R 175,176	-	-	-	1,00 kΩ	RF 3100
R 177	-	-	-	681 Ω	RF 2681
R 178	-	-	-	75,0 kΩ	RF 4750
R 179	-	-	-	750 kΩ	RF 5750
R 180	-	-	-	511 kΩ	RF 5511
R 181	-	-	-	324 kΩ	RF 5324
R 182	-	-	-	10,0 kΩ	RF 4100
R 183	-	-	-	49,9 kΩ	RF 4499
R 184	-	-	-	200 Ω	RF 2200
R 309,310	Carbon	-	5%	47 Ω	RB 1470
R 311,312	-	-	-	18 Ω	RB 1180
R 315	-	-	-	47 kΩ	RB 4470
R 316	-	-	-	3,9 MΩ	RB 6390

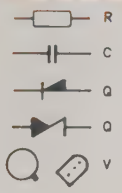
V 1,2	FET selected	N	E102	VB 1028
V 3-5	Silicon	NPN	BC107	VB 1032
V 6,7	FET selected	N	E102	VB 1013
V 8-11	Silicon	NPN	BC107	VB 1032
V 12,13	-	-	2N3053	VB 0251
V 14-17	-	-	2N3440	VB 0250
V 18,19	-	PNP	MM4003	VB 0068
V 28	-	NPN	ZTX341	VB 0514
V 29	-	-	2N3440	VB 0250
V 30	-	PNP	2N5416	VB 0087
V 31	Op. Amp.		301AN	VE 0017
V 32	Silicon	PNP	BCW62B	VB 0049
V 33,34	-	NPN	40407	VB 0054
V 35	-	PNP	40406	VB 0053
V 36	-	NPN	2N6292	VB 0548
V 37,38	-	PNP	2N6107	VB 0107
V 39	-	NPN	2N6292	VB 0548
V 40	-	-	BC107	VB 1032
V 41	-	PNP	BCW62B	VB 0049

	Heat Sink	DK 0413
	Heat Sink	DK 0414
	Heat Sink	DT 0040
	Printed Circuit Board	XC 0529

Layout Diagram with Parts List

ZG 0069





Viewed from the printed circuit side

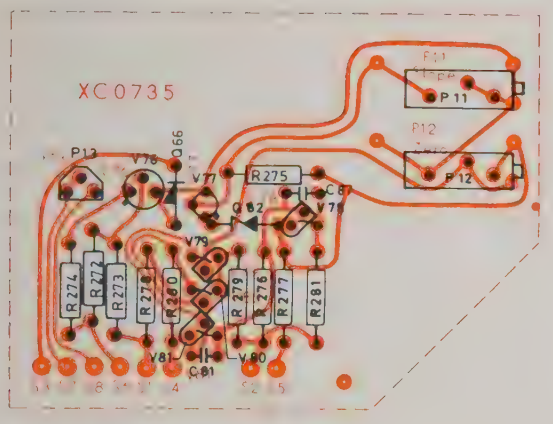
C 59-63	Electrolytic			22 µF/100 V	CE 0616
C 64,65	-			100 µF/ 25 V	CE 0443
C 66,67	Ceramic			1000 pF/500 V	CK 3100
C 70,71	Electrolytic			400 µF/ 40 V	CE 0417
C 78	Ceramic			1000 pF/500 V	CK 3100
C 79	-			120 pF/400 V	CK 2122
C 83,84	-			4,7 nF/ 50 V	CK 9102
O 7	Mini Relay			12 V	OC 0059
O 8	Mini Relay			24 V	OC 0037
Q 43,44	Zener	1N732A		53-59 V/4 mA	QV 1327
Q 45,46	-	ZG5,6		5,6-6,0 V/10 mA	QV 1107
Q 47,48	-	ZF9,1		8,5-9,6 V/5 mA	QV 1109
Q 49-56	Silicon	1N4004		400 V/1 A	QV 0237
Q 76	Zener	ZF16		15,3-17 V/5 mA	QV 1118
Q 79-81	Silicon	1N4004		400 V/1 A	QV 0237
Q 84,85	-	1N4004		400 V/1 A	QV 0237
Q 86,87	Zener	ZF16		15,3-17 V/5 mA	QV 1118
R 185,186	Metal	1/4 W	1%	3,01 kΩ	RF 3301
R 187	-	-	-	10,0 kΩ	RF 4100
R 188,189	-	-	-	15,0 kΩ	RF 4150
R 190,191	-	-	-	5,62 kΩ	RF 3562
R 192,193	-	-	-	2,00 kΩ	RF 3200
R 194,195	-	-	-	10,0 kΩ	RF 4100
R 196,197	-	-	-	4,22 kΩ	RF 3422
R 198-201	-	-	-	2,00 kΩ	RF 3200
R 202,203	Wire	4,2 W	5%	56 Ω	RX 0319
R 204-207	Metal	1/4 W	1%	1,00 kΩ	RF 3100
R 246	-	-	-	10,2 kΩ	RF 4102
R 247	-	-	-	16,2 kΩ	RF 4162
R 248	Metal	1/4 W	1%	15,0 kΩ	RF 4150
R 249	-	-	-	49,9 kΩ	RF 4499
R 250	-	-	-	10,0 kΩ	RF 4100
R 251	-	-	-	806 Ω	RF 2806
R 252	-	-	-	3,01 kΩ	RF 3301
R 253	-	-	-	12,1 kΩ	RF 4121
R 254	-	-	-	4,22 kΩ	RF 3422
R 255	Carbon	-	5%	220 kΩ	RB 5220
R 256	Metal	-	1%	1,00 kΩ	RF 3100
R 257,258	-	-	-	10,0 kΩ	RF 4100
R 259,260	-	-	-	324 Ω	RF 2324
R 261	-	-	-	100 kΩ	RF 5100
R 262	-	-	-	69,8 kΩ	RF 4698
R 263	-	-	-	20,0 kΩ	RF 4200
R 264	-	-	-	68,1 Ω	RF 1681
R 265	-	-	-	20,0 kΩ	RF 4200
R 266,267	-	-	-	4,99 kΩ	RF 3499
R 268	-	-	-	34,8 kΩ	RF 4348
R 269	-	-	-	5,62 kΩ	RF 3562
R 270	-	-	-	475 Ω	RF 2475
R 271	-	-	-	4,75 kΩ	RF 3475
R 287	-	-	-	20,0 kΩ	RF 4200
R 288,289	-	-	-	2,00 kΩ	RF 3200
R 290-295	-	-	-	10,0 kΩ	RF 4100
R 296,297	-	-	-	49,9 kΩ	RF 4499
R 298,299	-	-	-	221 kΩ	RF 5221
R 300,301	-	-	-	806 Ω	RF 2806
R 302,303	-	-	-	10,0 kΩ	RF 4100
R 306	Wire	1 W	2%	9,1 Ω	RO 0009
R 313,314	Carbon	1/4 W	5%	1,0 kΩ	RB 3100
R 317	Metal	-	1%	4,75 kΩ	RF 3475

ZG 0069 Parts List

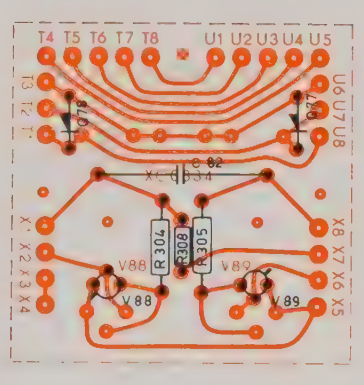
V 42	Silicon	NPN	40407	VB 0054
V 43	-	PNP	40406	VB 0053
V 44	-	NPN	40407	VB 0054
V 45	-	PNP	40406	VB 0053
V 46	-	NPN	BC107	VB 1032
V 47,48	-	PNP	BCW62B	VB 0049
V 49,50	-	NPN	BC107	VB 1032
V 51	-	PNP	BCW62B	VB 0049
V 65-67	-	PNP	BCW62B	VB 0049
V 68-74	-	NPN	BC107	VB 1032
V 75	-	PNP	BCW62B	VB 0049
V 84	-	NPN	BC107	VB 1032
V 85,86	-	PNP	BCW62B	VB 0049
V 87	-	NPN	BC107	VB 1032
	Heat Sink			DT 0036
	Printed Circuit Board			XC 0734

Layout Diagrams with Parts List

ZH 0083
ZH 0084
XZ 0028
XZ 0029



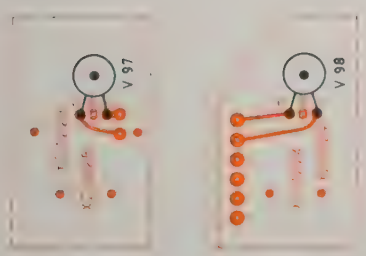
ZH 0083



ZH 0084

C 81	Ceramic			120 pF/400 V	CK 2122
C 87	-			1 nF/400 V	CK 3101
P 11,12	Trimmer		lin.	20 kΩ	PG 3206
P 13	Trimmer		-	220 Ω	PG 1220
Q 66	Silicon	1N4004		400 V/1 A	QV 0237
Q 82	Zener	ZG5,6		5,5-6,0 V/10 mA	QV 1107
R 272	Metal	1/4 W	1%	10,5 kΩ	RF 4105
R 273	-	-	-	40,2 kΩ	RF 4402
R 274	-	-	-	1,00 kΩ	RF 3100
R 275	-	-	-	7,50 kΩ	RF 3750
R 276	-	-	-	4,75 kΩ	RF 3475
R 277	-	-	-	2,00 kΩ	RF 3200
R 278	-	-	-	1,00 kΩ	RF 3100
R 279	-	-	-	20,0 kΩ	RF 4200
R 280	-	-	-	4,75 kΩ	RF 3475
R 281	-	-	-	100 Ω	RF 2100
V 76	Silicon		PNP	40406	VB 0053
V 77	-		NPN	BC107	VB 1032
V 78	-		PNP	BCW62B	VB 0049
V 79,80	-		NPN	BCW82B	VB 0055
V 81	-		PNP	BCW62B	VB 0049
	Printed Circuit Board				XC 0735

C 82	Polycarbonate			0,22 µF/630 V	CS 0128
Q 77,78	Silicon	1N4004		400 V/1 A	QV 0237
R 304,305	Metal	1/4 W	1%	100 Ω	RF 2100
R 308	-	-	-	215 kΩ	RF 5215
V 88,89	Triac			TAG201-500	VB 2502
	Printed Circuit Board				XC 0834



XZ 0028 XZ 0029

XZ 0028

V 97	Phototrans.	NPN	BPX70	VB 3500
	Printed Circuit Board			XC 1223

XZ 0029

V 98	Phototrans.	NPN	BPX70	VB 3500
	Printed Circuit Board			XC 1224
	Mounted bracket for XC 0028 and XC 0029			GV 1314
V 90	Lamp			VS 0007
	Socket for do			JO 0012

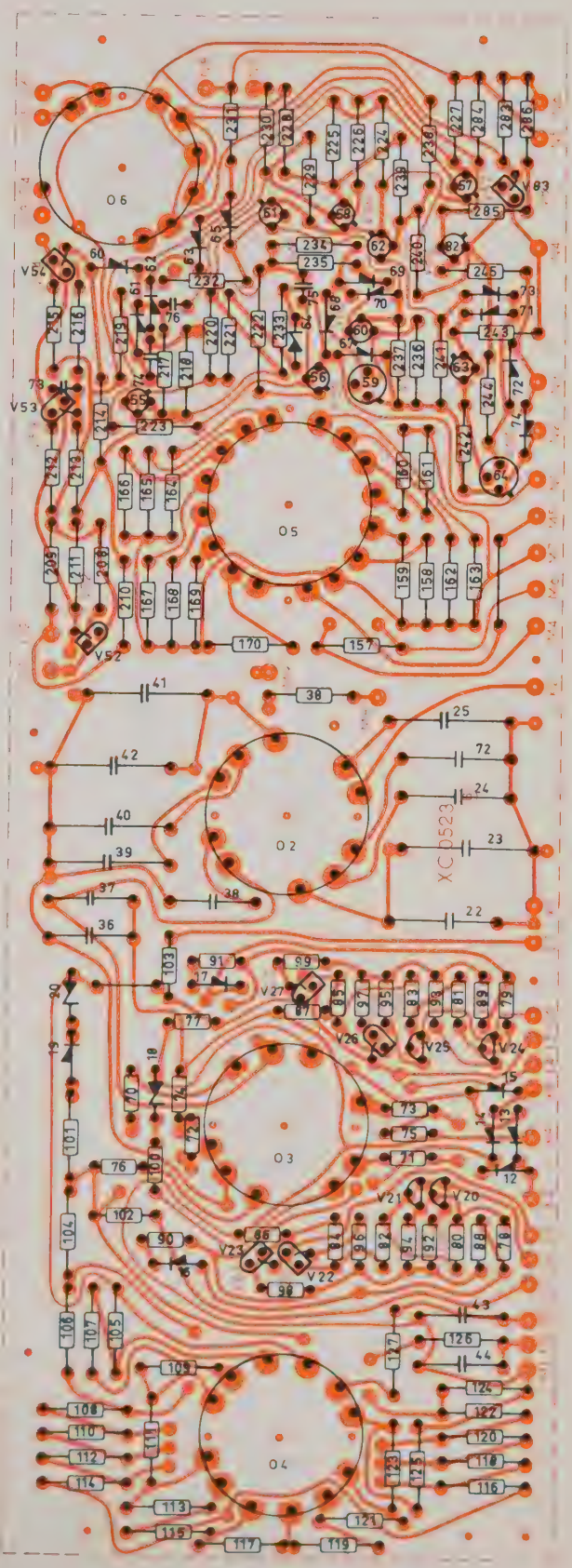
ZH 0083
ZH 0084

C 22	Electrolytic, Bipolar	10 µF/ 63 V	CE 0536
C 23	Polycarbonate	5,6 µF/100 V	CS 0346
C 24	-	2,2 µF/100 V	CS 0380
C 25	-	0,68 µF/100 V	CS 0342
C 36-38	Polyester	0,1 µF/250 V	CS 0013
C 39	-	0,33 µF/250 V	CS 0019
C 40	-	0,68 µF/250 V	CS 0023
C 41,42	-	2 µF/250 V	CS 0028
C 43,44	-	47 nF/250 V	CS 0009
C 72	Polycarbonate	1,5 µF/100 V	CS 0386
C 73	Ceramic	4,7 nF/100 V	CK 0096
C 74	-	100 nF/ 30 V	CK 5100
C 75	Tantalum	4,7 µF/ 35 V	CF 0051
C 76	Ceramic	22 nF/ 63 V	CK 4220
C 86	-	4,7 nF/100 V	CK 0096

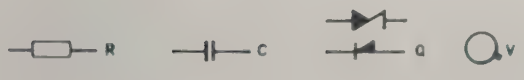
O 2	"Lower Limiting Frequency"	OF 0012
O 3	"Rectifier Response"	OF 0011
O 4	"Potentiometer Range"	OD 1020
O 5	"Writing Speed"	OF 0010
O 6	"Paper Drive Functions"	OF 0009

Q 12-15	Silicon	13P2	200 V/40 mA	QV 0022
Q 16,17	-	1N4148	75 V/75 mA	QV 0216
Q 18	Zener	1N723	21,6-26,4 V/4 mA	QV 1005
Q 19	Silicon	1N4004	400 V/1 A	QV 0237
Q 20	Zener	ZG5,6	5,0-6,0 V	QV 1107
Q 60-63	Silicon	1N4004	400 V/1 A	QV 0237
Q 64	Zener	ZF16	15,3-17 V/5 mA	QV 1118
Q 65	Silicon	1N4004	400 V/1 mA	QV 0237
Q 67-74	-	1N4004	400 V/1 mA	QV 0237

R 38	Metal	1/4 W	1%	100 kΩ	RF 5100
R 70,71	-	-	-	22,1 kΩ	RF 4221
R 72,73	-	-	-	23,2 kΩ	RF 4232
R 74,75	-	-	-	18,2 kΩ	RF 4182
R 76,77	-	-	-	22,1 kΩ	RF 4221
R 78,79	-	-	-	10,0 kΩ	RF 4100
R 80,81	-	-	-	5,23 kΩ	RF 3523
R 82,83	-	-	-	2,80 kΩ	RF 3280
R 84,85	-	-	-	1,54 kΩ	RF 3154
R 86,87	-	-	-	2,00 kΩ	RF 3200
R 88,89	-	-	-	49,9 kΩ	RF 4499
R 90,91	-	-	-	45,3 kΩ	RF 4453
R 92,93	-	-	-	17,4 kΩ	RF 4174
R 94,95	-	-	-	5,23 kΩ	RF 3523
R 96,97	-	-	-	1,65 kΩ	RF 3165
R 98,99	-	-	-	511 Ω	RF 2511
R 100	Carbon	-	5%	1,8 kΩ	RB 3180
R 101	Metal	-	1%	100 Ω	RF 2100
R 102,103	-	-	-	140 kΩ	RF 5140
R 104,105	-	-	-	13 kΩ	RF 4130
R 106,107	-	-	-	12,4 kΩ	RF 4124



Viewed from the printed circuit side



R 108,109	Metal	1/4 W	1%	9,09 kΩ	RF 3909
R 110,111	-	-	-	6,34 kΩ	RF 3634
R 112,113	-	-	-	4,99 kΩ	RF 3499
R 114,115	-	-	-	4,02 kΩ	RF 3402
R 116,117	-	-	-	2,87 kΩ	RF 3287
R 118,119	-	-	-	2,10 kΩ	RF 3210
R 120,121	-	-	-	1,91 kΩ	RF 3191
R 122,123	-	-	-	1,40 kΩ	RF 3140
R 124,125	-	-	-	4,99 kΩ	RF 3499
R 126,127	-	-	-	49,9 kΩ	RF 4499
R 157	-	-	-	475 kΩ	RF 5475
R 158	-	-	-	3,57 kΩ	RF 3357
R 159	-	-	-	10,5 kΩ	RF 4105
R 160	-	-	-	24,9 kΩ	RF 4249
R 161	-	-	-	42,2 kΩ	RF 4422
R 162	-	-	-	68,1 kΩ	RF 4681
R 163	-	-	-	115 kΩ	RF 5115
R 164	-	-	-	200 kΩ	RF 5200
R 165	-	-	-	348 kΩ	RF 5348
R 166	-	-	-	634 kΩ	RF 5634
R 167	-	-	-	249 kΩ	RF 5249
R 168	-	-	-	604 kΩ	RF 5604
R 169	-	-	-	1,40 MΩ	RH 6140
R 170	-	-	-	3,48 MΩ	RH 6348
R 208	-	-	-	24,9 kΩ	RF 4249
R 209	-	-	-	16,2 kΩ	RF 4162
R 210	-	-	-	15,0 kΩ	RF 4150
R 211	-	-	-	100 kΩ	RF 5100
R 212	-	-	-	2,67 kΩ	RF 3267
R 213	-	-	-	22,1 kΩ	RF 4221
R 214	-	-	-	10,0 kΩ	RF 4100
R 215,216	-	-	-	30,1 kΩ	RF 4301
R 217,218	-	-	-	200 kΩ	RF 5200
R 219	-	-	-	10,0 kΩ	RF 4100
R 220	-	-	-	100 kΩ	RF 5100
R 221	-	-	-	49,9 kΩ	RF 4499
R 222	-	-	-	1,00 kΩ	RF 3100
R 223	Metal	1/8 W	1%	20,0 kΩ	RF 4200
R 224	-	-	-	10,0 kΩ	RF 4100
R 225,226	-	-	-	49,9 kΩ	RF 4499
R 227,228	-	-	-	10,0 kΩ	RF 4100
R 229	-	-	-	20,0 kΩ	RF 4200
R 230,231	-	-	-	10,0 kΩ	RF 4100
R 232	-	-	-	20,0 kΩ	RF 4200
R 233	-	-	-	100 kΩ	RF 5100
R 234	-	-	-	10,0 kΩ	RF 4100
R 235	-	-	-	3,01 kΩ	RF 3301
R 236	-	-	-	10,0 kΩ	RF 4100
R 237	-	-	-	2,00 kΩ	RF 3200
R 238,239	-	-	-	20,0 kΩ	RF 4200
R 240	-	-	-	10,0 kΩ	RF 4100
R 241	-	-	-	2,00 kΩ	RF 3200
R 242	-	-	-	10,0 kΩ	RF 4100
R 243	-	-	-	3,01 kΩ	RF 3301
R 244	-	-	-	10,0 kΩ	RF 4100
R 245	-	-	-	20,0 kΩ	RF 4200
R 283,284	-	-	-	10,0 kΩ	RF 4100
R 285	-	-	-	20,0 kΩ	RF 4200
R 286	-	-	-	49,9 kΩ	RF 4499

V 20,21	Silicon	NPN	BC682	VB 0537
V 22,23	-	NPN	BCW82B	VB 0055
V 24,25	-	PNP	BC256B	VB 0092
V 26,27	-	PNP	BCW62B	VB 0049
V 52-54	-	PNP	BCW62B	VB 0049
V 55-58	-	NPN	BC107	VB 1032
V 59	-	PNP	40406	VB 0053
V 60-63	-	NPN	BC107	VB 1032
V 64	-	PNP	40406	VB 0053
V 82	-	NPN	BC107	VB 1032
V 83	-	PNP	BCW62B	VB 0049

	Printed Circuit Board	XC 0523

C 1-4	Polystyrene		270 pF/125 V	CT 1143
C 5	-		160 pF/125 V	CT 1130
C 6	Ceramic		47 pF/400 V	CK 1471
C 7	-		30 pF/400 V	CK 0105
C 8	-		65 pF/400 V	CK 0106
C 9	-		2,7 pF/400 V	CK 0270
C 10-12	-		68 pF/400 V	CK 1683
C 58	Electrolytic		47 µF/450 V	CE 0921
C 77	Polyester		0,22 µF/250 V	CS 0017
C 88	Paper		0,1 µF/630 V	CP 0033

J 1	Input ground Socket	JT 6204
J 2	Input Socket B & K	JJ 0108
J 3	Input Socket BNC	JJ 0121

N 1	100 mV Ref. Switch	NT 0033
N 2	Range Potm. I/O	DU 0002 + OD 0106
N 3	Pen Drive Switch	NN 0014
N 4	Range Potentiometer "In-Out" Switch	NT 0021
N 5	Stop Switch	NT 0023
N 6	Start Switch	NT 0023
N 7	Event Marker Switch	NT 0023
N 8	Drive Shaft II Cam-Switch	NT 0013
N 9	On-Off Switch	NN 0015

O 1	Input Attenuator			OX 2305
O 2	Lower Limiting Freq.	Mech. Parts		OD 1026
O 3	Rectifier Response	-	-	OD 1027
O 4	Potentiometer Range	-	-	OD 1028
O 5	Writing Speed	-	-	OD 1024
O 6	Paper Drive Functions	-	-	OD 1025

P 1	Wire-wound	lin.	22 kΩ	PQ 3220
P 10	-	-	10 kΩ	PQ 3107

R 1	Carbon	1/4 W	1%	27,4 kΩ	RF 4274
R 2	-	-	-	54,9 kΩ	RF 4549
R 3	-	-	-	27,4 kΩ	RF 4274
R 4	-	-	-	8,45 kΩ	RF 3845
R 5	-	-	-	182 kΩ	RF 5182
R 6	-	-	-	16,9 kΩ	RF 4169
R 7	-	-	-	11,5 kΩ	RF 4115
R 8	-	-	-	22,6 kΩ	RF 4226
R 9	-	-	-	2,80 kΩ	RF 3280
R 10	-	-	-	24,3 kΩ	RF 4243
R 11	-	-	-	825 Ω	RF 2825
R 12	-	-	-	24,9 kΩ	RF 4249
R 13	-	-	-	255 Ω	RF 2255
R 14	-	-	-	24,9 kΩ	RF 4249
R 15	-	-	-	54,9 Ω	RF 1549
R 16	-	-	-	24,9 Ω	RF 1249
R 152	Wire	5,5 W	10%	220 Ω	RX 0312
R 318	Metal	1/4 W	1%	1,96 MΩ	RH 6196
R 500	-	-	-	6,19 MΩ	RH 6619

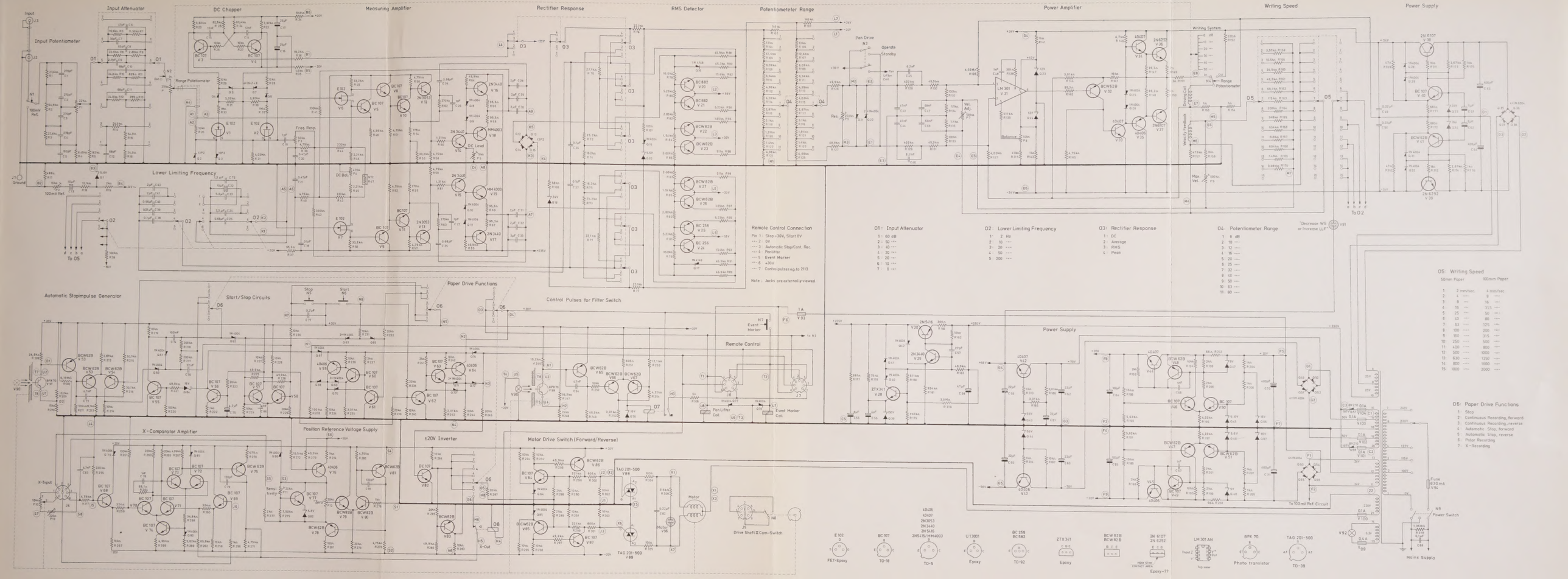
V 91	Neon Lamp	VS 0013
V 92	Panel Lamp	VS 8024
V 93	Fuse 1 A	VF 0008
V 94	Fuse 630 mA	VF 0032
V 96	Neon Lamp	VS 0013
V 99	Fuse 100 mA	VF 0026
V 100-104	Fuses 400 mA	VF 0039

Z 2	50 dB Potentiometer	ZR 0005

Power Cord	AN 0010
Center Tap f. Polar Paper	DB 1457
Bakelite foot f. cabinet	DF 7026
Side Cover	DZ 9051
Nylon gear wheel 22-22 f. 50 Hz	DG 0233
Nylon gear wheel 20 f. 60 Hz	DG 0232
Nylon gear wheel 24 f. 60 Hz	DG 0234
Event marker stylus	DH 2003
Recording stylus	DH 2003
Recording pen	DH 2001
Paper cutter	GU 0861
BNC Socket	JJ 0130
Socket, 7-pin DIN Remote Control	JJ 0709
Socket, 8-pin DIN Cam-Switch	JJ 0802
Socket, 8-pin DIN X-Recording	JJ 0802
Socket, Panel Lamp	JO 0012
Socket for Lamp	JO 0030
Plug, Coaxial Input	JP 0101
Plug, 7-pin DIN	JP 0703
Plug, 8-pin DIN	JP 0802
Mains Socket	OA 0042
Cam disc, short pulse	OD 0060
Cam disc, 90°	OD 0061
Inking Kit	QI 0002
Knob, 31,5 mm	SN 3207
Retaining ring for knob	DB 0850
M4 Allen screw for do	YQ 2083
2 mm Allen key for above	QA 0043
Knob, gear shift	SN 0827
Power transformer	TN 0030
Paper guide	UA 2001
Writing system, complete	UA 2002
Gear box, complete with motor	UG 0087
Motor	UM 0020
Solenoide for Pen Lift/Even Marker	UM 0024
Friction clutch	UC 0094
Magnetic drive system	UM 0801
Slider for Potentiometer	UA 0164
Spring for Slider	DL 3037
Elapsed Time Meter	VU 9008
Stand-off	XL 0147
Photodiode, complete	XZ 0033

Printed Circuit Boards:

XC 0115 with components	ZA 0004
XC 0833 with components	ZA 0005
XC 0529 with components	ZE 0100
XC 0734 with components	ZG 0069
XC 0735 with components	ZH 0083
XC 0834 with components	ZH 0084
XC 0523 with components	ZL 0034
XC 1223 with components	XZ 0028
XC 1224 with components	XZ 0029


Input Attenuator
DC Chopper
Measuring Amplifier
Rectifier Response
RMS Detector
Potentiometer Range
Power Amplifier
Writing Speed
Power Supply
Input Potentiometer
Range Potentiometer
Freq. Resp.
DC Level
DC Bal.
Lower Limiting Frequency
Automatic Stopimpulse Generator
Start/Stop Circuits
Paper Drive Functions
Control Pulses for Filter Switch
Remote Control
Remote Control Connection
Pin 1: Stop -30V, Start 0V
--- 2: 0V
--- 3: Automatic Stop/Cont. Rec.
--- 4: Penlifter
--- 5: Event Marker
--- 6: +30V
--- 7: Controlpulses eg.to 2113
Note: Jacks are externally viewed.
X-Comparator Amplifier
Position Reference Voltage Supply
±20V Inverter
Motor Drive Shift (Forward/Reverse)
Power Supply
Writing System
Pen Drive N3
Operate
Standby
Pen Lifter Coil
Event Marker Coil
Motor
Drive Shaft
Com-Switch
Power Switch
Mains Supply
To 05
To 02
To 109 mV Ref. Circuit
Decrease WS or Increase LLF
Range Potentiometer
Balance
Vel. Adj.
Max. Vel.
Writing Speed Control
Position Control
Pen Lift Control
Q1: Input Attenuator
1: 60 dB
2: 50 ---
3: 40 ---
4: 30 ---
5: 20 ---
6: 10 ---
7: 0 ---
Q2: Lower Limiting Frequency
1: 2 Hz
2: 10 ---
3: 20 ---
4: 50 ---
5: 200 ---
Q3: Rectifier Response
1: DC
2: Average
3: RMS
4: Peak
Q4: Potentiometer Range
1: 0 dB
2: 10 ---
3: 12 ---
4: 16 ---
5: 20 ---
6: 25 ---
7: 32 ---
8: 40 ---
9: 50 ---
10: 63 ---
11: 80 ---
Q5: Writing Speed
50mm Paper
100mm Paper
1: 2 mm/sec. 4 mm/sec
2: 4 --- 8 ---
3: 8 --- 16 ---
4: 16 --- 31.5 ---
5: 25 --- 50 ---
6: 40 --- 80 ---
7: 63 --- 125 ---
8: 100 --- 200 ---
9: 160 --- 315 ---
10: 250 --- 500 ---
11: 400 --- 800 ---
12: 500 --- 1000 ---
13: 630 --- 1250 ---
14: 800 --- 1600 ---
15: 1000 --- 2000 ---
Q6: Paper Drive Functions
1: Stop
2: Continuous Recording, forward
3: Continuous Recording, reverse
4: Automatic Stop, forward
5: Automatic Stop, reverse
6: Motor Recording
7: X-Recording
FET-Epoxy
TO-18
TO-5
Epoxy
TO-92
Epoxy
Epoxy-77
Photo transistor
TO-39